City Density and CO$_2$ Efficiency
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Studies done so far at different spatial scales on estimating the relationship between urban population density and energy consumption (and/or GHG emissions) showed different results.

The methodology used for analysis (though internally consistent) varied significantly (especially with respect to GHG emissions comparison).
Data and Methods

- Gridded Urban extents data (from GRUMP and GlobLandcover)
- Gridded Population count and Population density (from GRUMP)
- Gridded residential, commercial and onroad emissions data (from Vulcan Project)

City Clustering Algorithm (CCA)

Unique urban extents with corresponding population density and sectoral emissions at various threshold distances
Comparision of GRUMP and GLC Urban Extents

- **New York**
- **Philadelphia**
- **Washington (D.C)**

- **Milwaukee**
- **Chicago**

**GRUMP_On-Road_Emissions**
- Value:
  - High: 354346
  - Low: 0

**GLC_On-Road_Emissions**
- Value:
  - High: 411133
  - Low: 0

*All emissions reported in tonnes of carbon dioxide*
Comparision of GRUMP and GLC Urban Extents (contd.)

* All emissions reported in tonnes of carbon dioxide
Key Results

1. We found that CO\(_2\) efficiency increased with increase in population density for both landuse datasets used.

2. Our analysis suggests that doubling the population density would lead to reduction in CO\(_2\) emissions at least by 35%.

3. The influence of population density is more pronounced in the case of on-road emissions than emissions from buildings (residential and commercial) for largest emitting 500 clusters.
The building emissions per capita are found to be more than the onroad emissions per capita. This trend is found only in MSA’s which are located in colder regions.

The density where both emissions are low is found to be different from one MSA to another.
Study Implications

City Density and CO$_2$ Efficiency

Irrespective of the data sets used, the CO$_2$ efficiency improved with increasing density.

The study suggests an objective approach to find the relationship between city density and GHG emissions that is consistent across spatial scales and emission inventory.

High dense settlements: Options that focus on decreasing household energy consumption
Low and medium dense settlements: Improving public transportation

Study Limitations:
- The impact of increased electricity consumption (and therefore the subsequent GHG emissions) in high dense settlements still unclear
Thank You!!!

Planned Submission: „City Density and CO₂ Efficiency“, Ramana Gudipudi, Till Fluschnik, Anselmo Cantu, Carsten Walther, Juergen Kropp, 2015